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CLAIMS

1. A method for detecting a fault in a system, comprising:
obtaining a measurement for each of a plurality of variables corresponding to the operational state of the system;
5 ranking the variables by the reliability of the measurement for each of the plurality of variables to provide a ranked list of the variables;
selecting a first subset of the most reliable variables from the ranked list to provide a set of independent variables; and
calculating expected system dependent variables using the set of independent variables
10 to detect the fault.
2. The method of claim 1 wherein the system is selected from the group consisting of an aircraft engine, a rocket propulsion system, and an aerospace vehicle.
- 15 3. The method of claim 1 wherein measuring the plurality of variables comprises sensing operating conditions using at least one sensor.
4. The method of claim 1 wherein the reliability of the measurement is based on the confidence of accurately obtaining the measurement for each of the plurality of variables.
- 20 5. The method of claim 1 wherein calculating expected system dependent variables comprises:
developing a model corresponding to the system; and
formulating the model to calculate the expected system dependent variables based on
25 the set of independent variables.
6. The method of claim 1 further comprising:
selecting a second subset of variables from the ranked list to provide a set of measured

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dependent variables; and

comparing the expected system dependent variables to the set of measured dependent variables.

- 5 7. The method of claim 6 wherein the comparing comprises residual analysis.
8. The method of claim 5 wherein the model comprises a physical model corresponding to the system.
- 10 9. The method of claim 8 wherein the physical model comprises a model update scheme.
10. The method of claim 9 wherein the model update scheme comprises a correction factor based on data collected from operation of the system.
- 15 11. The method of claim 1 wherein at least one of the set of independent variables is measured using hardware redundancy.
12. The method of claim 11 wherein the hardware redundancy comprises measuring the at least one of the set of independent variables using at least two hardware measuring devices.
- 20 13. The method of claim 12 wherein the measuring devices are sensors.
14. The method of claim 1 wherein the expected system dependent variables are calculated substantially only using the set of independent variables.
- 25 15. The method of claim 1 wherein the fault is an anomaly.

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16. A computer-readable medium comprising a computer program for operating a computer system to detect a fault in a physical system according to the method of claim 1.

17. An apparatus for detecting a fault in a physical system, the apparatus comprising a computer system coupled for receiving a plurality of measured variables from the physical system corresponding to conditions of the physical system, wherein the computer system performs fault detection by determining estimated system operating conditions for the physical system using a hardware redundant subset of the plurality of measured variables.

18. The apparatus of claim 17 wherein the computer system performs fault detection by determining estimated system operating conditions for the physical system using substantially only a hardware redundant subset of the plurality of measured variables.

19. The apparatus of claim 17 wherein the hardware redundant subset corresponds to a most reliable subset of the plurality of measured variables.

20. The apparatus of claim 17 further comprising a plurality of sensors each having an input coupled to measure an operating condition of the physical system, wherein at least two of the plurality of sensors correspond to the hardware redundant subset.

21. The apparatus of claim 17 further comprising a control system coupled to control the physical system and having an input coupled to the computer system, wherein the control system provides a control signal to the physical system in response to a fault signal received from the computer system.

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22. A method for detecting a fault in a system, comprising:

obtaining a hardware redundant measurement for each of a plurality of variables corresponding to the operational state of the system; and

5 using a model to calculate expected system dependent variables, using the plurality of variables as a set of independent variables in the model, to detect the fault.

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DOCKET "E2692/60